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(58) Documents cited  
None

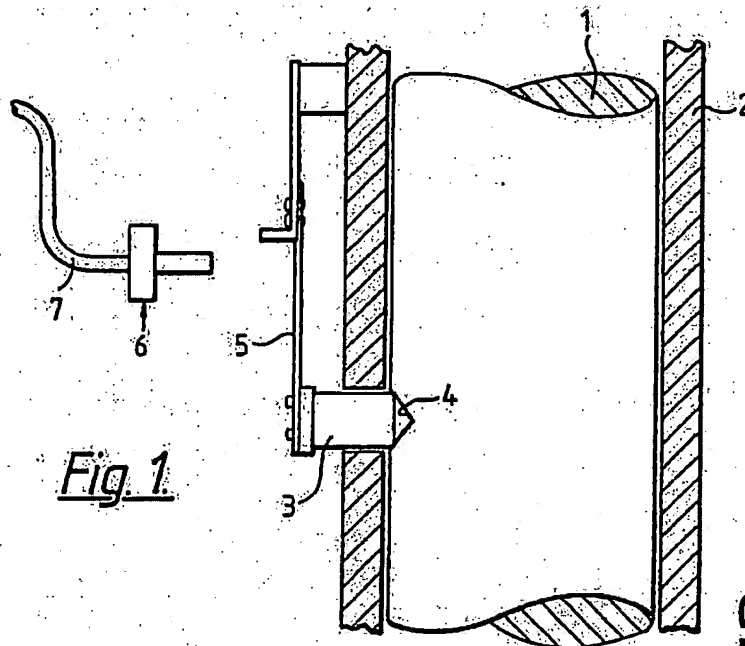
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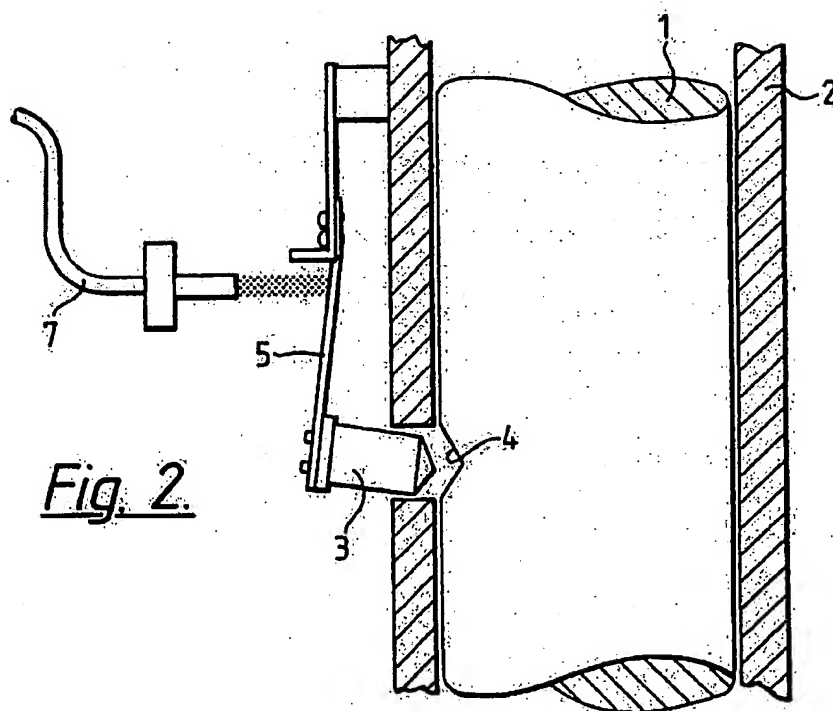
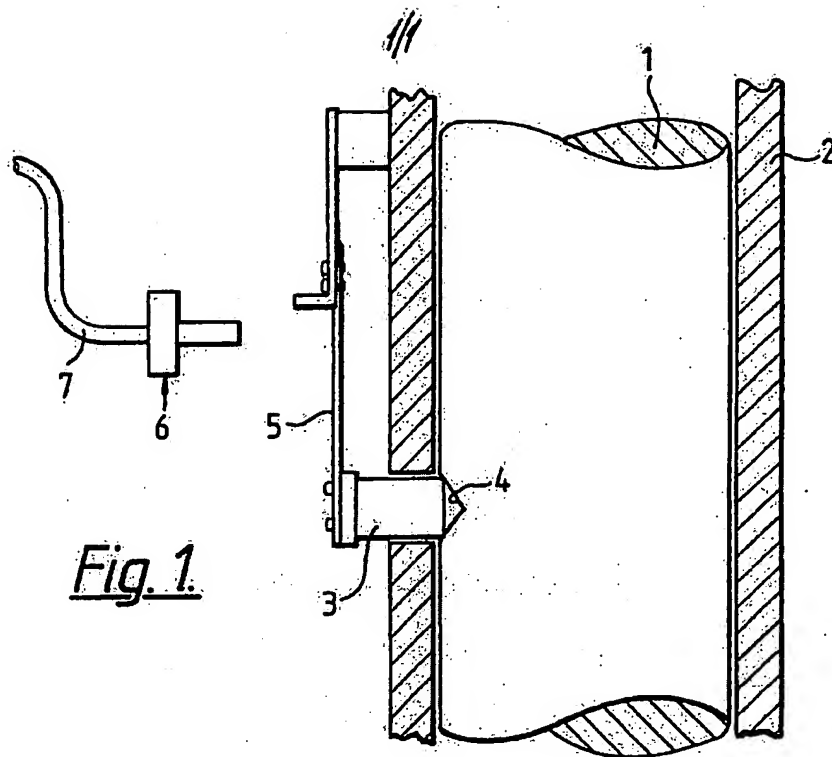
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## (54) Locking arrangement for connectors

(57) Two connector portions (1, 2) are locked in the coupled-together state by means of a locking pin (3) engaged in a locking recess (4) of one portion (1). The locking pin (3) is carried by an element (5) of shape memory metal comprised as a leaf spring or compression spring. To retract the locking pin (3) for coupling or uncoupling of the connector portions (1, 2) the element (5) is heated by optical power supplied thereto from a remote laser source via an optical fibre cable (7) with a lens termination (6). Upon cooling of the element the locking pin is returned and extends into the bore of the portion (2) in the absence of a portion (1).



GB 2 166 185 A



## SPECIFICATION

## Locking arrangements for connectors

This invention relates to locking arrangements, and in particular to the remote actuation of such arrangements and remote locking and unlocking of fibre optic connectors.

Interest is currently being expressed, in the off-shore oil industry, regarding the idea of replacing off-shore platforms from which oil well valves etc are operated by cable incorporating fibre-optics; whereby the valves etc can be operated remotely, and in particular from the shore.

There are various possibilities whereby the two halves of an optical fibre connector can be mated subsea; remotely or otherwise. The present invention is, however, particularly concerned with the remote locking and unlocking of such connections:

According to one aspect of the present invention there is provided a locking arrangement comprising a first member; a second member; the first member having an aperture adapted to receive the second member, which is of corresponding dimensions thereto and is to be locked to the first member; a locking pin; an element of shape memory material carrying the locking pin; and means for supplying optical power from a remote laser source to the element for heating thereof, wherein upon such heating of the element the locking pin is retracted from the aperture to permit entry of the second member into the first member, or to permit removal therefrom; and wherein when the element is not so heated the locking pin extends into the aperture and, when the second member is located in the first member, into a corresponding locking aperture of the second member whereby to lock the first and second members together.

According to another aspect of the present invention there is provided a method of remotely locking and unlocking a first member to a second member, the first member having an aperture, adapted to receive the second member which is of corresponding dimensions thereto, and a locking pin which extends into the aperture and into a locking aperture of the second member in the locked-together coupled state of the two members, which locking pin is carried by an element of shape memory material; the method including the step of heating the element; by optical power supplied thereto from a remote laser source over an optical fibre cable, whereby to retract the locking pin from the aperture to permit entry of the second member into the first member for coupling and locking; or to permit removal of the second member from the first member for unlocking and uncoupling, and wherein upon subsequent cooling of the element the locking pin is inserted into the locking aperture for locking of the two members coupled together; or inserted into the aperture following uncoupling of the two members, respectively.

Embodiments of the invention will now be described with reference to the accompanying drawings in which:

Fig. 1 shows, schematically, the connector locked

condition; and

Fig. 2 shows, schematically, the connector unlocked condition.

In Fig. 1, reference numeral 1 represents a member, typically an unanchored connector element, which is locked in position relative to a sleeve 2 by means of a locking pin 3; the sleeve 2 comprising a portion of an anchored connector element. It is assumed for the purposes of connector locking that in the locked position of the connector elements (halves), the pin 3 engages with a correspondingly shaped locking aperture 4 in the connector element 1.

The locking pin is mounted at one end of a strip 5 of shape material (metal) which is mounted to be sleeve 2 at its other end. The strip 5 is formed as a leaf spring and is mounted to the sleeve 2 such that in its "normal" (cold) position the pin 3 is in its locking position, as shown in Fig. 1, that is extending into the bore of sleeve 2 in the absence of element 1. Mounted adjacent the strip 5 is a terminating lens arrangement 6 for an optical fibre cable 7. By using a high optical power (100mw) it is possible to send a reasonable amount of optical energy down the fibre optic cable 7 in order to heat the memory metal strip 5. When the strip 5 is so heated it bends and retracts the pin 3 from the locking aperture 4 (Fig. 2), thus enabling the connector element 1 to be removed from the sleeve 2.

The locking arrangement described above will be used as follows. With the strip 5 optically heated and the pin 3 retracted the connector housing 1 can be inserted into the sleeve 2 and thus coupled thereto whereby, for example, connect valve optical fibres. Once the coupling is made the optical heating is terminated by ceasing to send optical power along cable 7. The memory metal strip then cools and readopts the configuration shown in Fig. 1 with the pin 3 engaged with the element disposed 1 in sleeve 2. In order to subsequently disconnect the coupling, the strip 5 must first be reheated by sending optical power along cable 7 until the elements have been disconnected.

Thus there is provided a method and means of remotely locking and unlocking a connector, which may be employed for connecting elements other than optical fibre cables, by the use of fibre optics. No electrical power transmission or operator at the connector is required.

Whereas a memory metal leaf spring has been described, it may alternatively comprise a memory metal compression spring.

## CLAIMS

1: A locking arrangement comprising a first member; a second member; the first member having an aperture adapted to receive the second member, which is of corresponding dimensions thereto and is to be locked to the first member; a locking pin; an element of shape memory material carrying the locking pin; and means for supplying optical power from a remote laser source to the element for heating thereof, wherein upon such heating of the element the locking pin is retracted

from the aperture to permit entry of the second member into the first member, or to permit removal therefrom, and wherein when the element is not so heated the locking pin extends into the aperture.

- 5 and, when the second member is located in the first member, into a corresponding locking aperture of the second member whereby to lock the first and second members together.

2. A locking arrangement as claimed in claim 1, wherein the element of shape memory material comprises a memory metal leaf spring.

3. A locking arrangement as claimed in claim 1, wherein the element of shape memory material comprises a memory metal compression spring.

- 15 4. A locking arrangement as claimed in any one of the preceding claims, wherein the first and second members comprise fibre optic cable connector elements.

5. A locking arrangement substantially as herein described with reference to the accompanying drawings.

6. A method of remotely locking and unlocking a first member to a second member, the first member having an aperture adapted to receive the second member which is of corresponding dimensions thereto, and a locking pin which extends into the aperture and into a locking aperture of the second member in the locked-together coupled state of the two members, which locking pin is carried by an element of shape memory material, the method including the step of heating the element, by optical power supplied thereto from a remote laser source over an optical fibre cable, whereby to retract the

- 35 locking pin from the aperture to permit entry of the second member into the first member for coupling and locking, or to permit removal of the second member from the first member for unlocking and uncoupling, and wherein upon subsequent cooling of the element the locking pin is inserted into the locking aperture for locking of the two members coupled together, or inserted into the aperture following uncoupling of the two members, respectively.

7. A method as claimed in claim 6, wherein the element of shape memory material comprises a memory metal leaf spring.

8. A method as claimed in claim 6, wherein the element of shape memory material comprises a memory metal compression spring.

- 50 9. A method as claimed in any one of claims 6 to 8, wherein the first and second members comprise fibre optic cable connector elements.

10. A method of remotely locking and unlocking a first member to a second member substantially as herein described with reference to the accompanying drawings.

11. A locking arrangement comprising a first member; a second member; the first member adapted to receive the second member, which is of corresponding dimensions thereto and can be locked to the first member by a locking part; an element of shape memory material carrying the locking part; and means for supplying optical power from a remote laser source to the element for heating thereof to unlock the first and second members.